



TECHNICAL PAPER

# STANDARDIZED UXO DEMONSTRATION SITES

**HUMAN FACTORS APPLICATIONS, INC. – MAGNETOMETER SCHONSTEDT/  
HAND HELD - MOGULS SCORING RECORD NO. 587**



The Magnetometer Schonstedt is shown being demonstrated by Human Factors Applications, Inc. at Yuma Proving Ground, Arizona.

*The Magnetometer Schonstedt was demonstrated by Human Factors Applications, Inc. at the Yuma Proving Ground Standardized Demonstration Site's Moguls Area. This technical paper contains the results of that demonstration. This is a reference document only and does not serve as an endorsement of the demonstrator's product by the US Army or the Standardized UXO Technology Sites Program.*

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**T**echnologies under development for the detection and discrimination of unexploded ordnance (UXO) require testing so that their performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland and Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multi-agency program spearheaded by the U.S. Army Environmental Center (USAEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

## DEMONSTRATOR'S SYSTEM AND DATA PROCESSING DESCRIPTION

Schonstedt 52Cx Ordnance Locator. Schonstedt Magnetometers are ferrous metal locators and will only detect "iron" or magnetic materials. The size and orientation of the target and the soil characteristics of the work area limit the depth of detection. The instrument is not capable of classifying the anomaly; it will only indicate the presence or absence of a magnetic anomaly. Schonstedt Magnetometers do not require calibration. They have a simple battery function test and a "Go"/"No Go" field operational check. The magnetometers will be set in accordance with the manufacturer's handbook to the sensitivity required to detect subsurface anomalies on the project site.

## PERFORMANCE SUMMARY

Results for the Moguls test broken out by size, depth and nonstandard ordnance are presented in table below. Results by size and depth include both standard and nonstandard ordnance. The results by size show how well the demonstrator did at detecting/discriminating ordnance of a certain caliber range. The results are relative to the number of ordnance items emplaced. Depth is measured from the geometric center of anomalies.

The Response Stage results are derived from the list of anomalies above the

demonstrator-provided noise level. The results for the Discrimination Stage are derived from the demonstrator's recommended threshold for optimizing UXO field cleanup by minimizing false digs and maximizing ordnance recovery. The lower 90 percent confidence limit on probability of detection and Pfp was calculated assuming that the number of detections and false positives are binomially distributed random variables. All results have been rounded to protect the ground truth. However, lower confidence limits were calculated using actual results.

The overall ground truth is composed of ferrous and non-ferrous anomalies. Due to limitations of the magnetometer, the non-ferrous items cannot be detected. Therefore, the summary presented in the "Ferrous Only" table exhibits results based on the subset of the ground truth that is solely the ferrous anomalies. The second table exhibits results based on the full ground truth. The response stage noise level and recommended discrimination stage threshold values are provided by the demonstrator.

## SUMMARY OF MOGUL RESULTS (FERROUS ONLY)

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
RESPONSE STAGE									
P <sub>1</sub>	0.60	0.60	0.65	0.60	0.60	0.65	0.70	0.50	0.30
P <sub>1</sub> Low 90% Conf	0.55	0.51	0.52	0.49	0.50	0.46	0.63	0.36	0.08
P <sub>1</sub> Upper 90% Conf	0.68	0.69	0.74	0.70	0.73	0.80	0.80	0.61	0.60
P <sub>2</sub>	0.80	-	-	-	-	-	0.85	0.60	0.50
P <sub>2</sub> Low 90% Conf	0.77	-	-	-	-	-	0.82	0.49	0.05
P <sub>2</sub> Upper 90% Conf	0.84	-	-	-	-	-	0.90	0.71	0.95
BAR	0.25	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P <sub>1</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>1</sub> Low 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>1</sub> Upper 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>2</sub>	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>2</sub> Low 90% Conf	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>2</sub> Upper 90% Conf	N/A	-	-	-	-	-	N/A	N/A	N/A
BAR	N/A	-	-	-	-	-	-	-	-

Response Stage Noise Level: 0.00  
Recommended Discrimination Stage Threshold: 0.00

## SUMMARY OF MOGUL RESULTS (FULL GROUND TRUTH)

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
RESPONSE STAGE									
P <sub>1</sub>	0.55	0.50	0.60	0.45	0.60	0.65	0.60	0.40	0.30
P <sub>1</sub> Low 90% Conf	0.46	0.41	0.47	0.35	0.50	0.46	0.52	0.30	0.08
P <sub>1</sub> Upper 90% Conf	0.59	0.57	0.68	0.53	0.73	0.80	0.68	0.54	0.60
P <sub>2</sub>	0.80	-	-	-	-	-	0.85	0.60	0.50
P <sub>2</sub> Low 90% Conf	0.77	-	-	-	-	-	0.82	0.49	0.05
P <sub>2</sub> Upper 90% Conf	0.84	-	-	-	-	-	0.90	0.71	0.95
BAR	0.25	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P <sub>1</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>1</sub> Low 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>1</sub> Upper 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>2</sub>	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>2</sub> Low 90% Conf	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>2</sub> Upper 90% Conf	N/A	-	-	-	-	-	N/A	N/A	N/A
BAR	N/A	-	-	-	-	-	-	-	-

Response Stage Noise Level: 0.00  
Recommended Discrimination Stage Threshold: 0.00

**Note:** The recommended discrimination stage threshold values are provided by the demonstrator. No discrimination algorithm was applied. Therefore, the discrimination stage results are not applicable.

To view the full Scoring Record for this demonstration and for all other demonstrations conducted at the Aberdeen and Yuma Proving Grounds in support of the Standardized UXO Technology Demonstration Sites Program please visit our Web site at: [www.uxotestsites.org](http://www.uxotestsites.org).